To: Dermer, Michele[Dermer.Michele@epa.gov]
From: Albright, David
Sent: Tue 1/13/2015 10:19:36 PM
Subject: Fw: AE Example provided by EPA

Fyi

Sent from my BlackBerry 10 smartphone on the Verizon Wireless 4G LTE network.

[redacted]

David:

The Division is looking at the example aquifer exemptions you provided to us in order to get a better handle on what is expected. We have reviewed one and are working with Michelle to get copies of the other two. With that said, below are comments from staff regarding the Slawson application. We thought it best to pass on staff's thoughts. I look forward to talking with you upon your return from Bakersfield.

Thanks,

Rob

In regards to the Slawson Exploration aquifer exemption submitted by David Albright as an example application…..

Slawson's Aquifer Exemption request is for a *single well* WD project with a 1/2 mile radius and is prepared and presented more like a one-well UIC project application with an AOR, well casing diagrams, etc. However, there are absolutely no geological exhibits, type logs, or cross

sections. Really it's more like a hybrid application for both injection and exemption, including a well AOR evaluation and an exemption request.

The Exemption component is based on Exemption based on

•□□□□□□□ 146.4(a) – Not currently used as a source of drinking water, and;

•□□□□□□□ 146.4 (b) (2) – Situated at a depth or location which makes recovery of water for drinking water purposes economically or technically impractical.

In regards to it not being a source of drinking water, there is no declaration by any water agency to this effect, so apparently the Region 9 doesn't seem to feel this is a necessity.

Further, it doesn't take into account any hydraulic gradients and the possible migration of injected water to any locations outside of a calculated radius of influence. Slawson merely calculated the radius of influence of a single injector and determined an aquifer exemption area consisting of a 1,900 foot radius circle.

Slawson used the simple displacement approach to calculate the radius of influence based on forecasted total injection (this is the same maligned approach that some people once wanted to use for calculating an AOR's ZEI, despite its complete disregard for pressure within an AOR). That said, even ignoring pressure considerations (which would fine for radius of influence at *ultimate* pressure dissipation and equilibrium), it yields a unrealistically pessimistic radius, since it requires 100% displacement of connate fluids, perfect aquifer homogeneity, some degree of effective permeability in every direction, and completely ignores the effects of any hydrodynamic regime in the area (which seems to be very important to the region 9 EPA and State WB staff).

Perhaps this approach could be scaled up for a larger EOR project with a wild *guess* made of *net* injection (cognizant of EOR production) for the *future* development of the exemption area (*guestimated* well density, injection patterns, and the like) and then a *project* radius of influence be detrimental manually or via computer simulation. This would probably be a rather nebulous calculation, but perhaps it could establish some sort of limit. But again, it would still ignore any induced or natural hydrodynamic influence.

After reading this application and given their concerns expressed in meetings, I can only guess that the Region 9 EPA staff may not have actually read it, or, perhaps their use of hydrodynamic nonmenclature in discussions may be inappropriate and that what they really want is simply a calculation of maximum possible radial *displacement* of connate waters by injectate.

In establishing that the aquifer is situated at a depth or location which makes recovery of water for drinking water purposes economically or technically impractical, Slawson's argument is based on the availability prolific, better water quality, shallower aquifers and that fact that drilling and completing one of these aquifers (at 200-1,805 foot depths) would be considerably less expensive than drilling an exemption zone well (Inya Kara zone) well (5,444 foot deep) with poorer water quality. Then in summary, they say "it is *Slawson's opinion* the proposed exempt aquifer is situated at a depth which makes recovery for USDW purposes economically impractical."

To demonstrate availability in the shallow aquifers, a census extrapolation and calculation recoverable water in these aquifers (per person) is compared to an EPA assessment EPA that the average American family uses 0.084 acre feet per year. This results in a determination that current aquifers can provide 520 acre feet of recoverable water per person in the County.

Since this application is not for an extension of a "hydrocarbon bearing" zone, it really doesn't apply well to our more immediate need for a model for expansion of EOR operations in an existing exempted aquifer. In some ways it is the antithesis of what we've been told by EPA staff:

- It includes absolutely no geological exhibits, cross sections, or type logs (only a cursory description of stratigraphy)

- Exemption area is for only 260 acres (circle of radius 1900'), rather than the area wide exemptions requested by EPA staff.

- Etc.

The fact that the State of North Dakota has *previously (in 2010) regionally exempted the injection zone (Inyan Kaya aquife) as an exempt aquifer under North Dakota Administrative Code*, may have some bearing on the lack of any detailed geology, etc. in the application. It may

well be that much of the documentation prepared and presented (if any) in that determination may have been taken into consideration when approving this application. Also, it is unclear why the operator made both the UIC and AE application directly to the EPA rather than the North Dakota Industrial Commission which has primacy for Class II wells in ND.

A few other things I found interesting:

•□□□□□□□ As a side note…all TDS calcs presented in the Slawson AE application package were determined by *calculation* from conductivity measurements even though actual water samples were provided to the lab. The preferred EPA method of calculating TDS is EPA Method 160.1, which *directly* weighs TDS residue.

•□□□□□□□ While the receiving aquifer runs 6,500-7,769 ppm TDS, the Bakken and Three Forks produced water injectate runs 266,664 – 284,800 ppm TDS. Apparently ND has no Water Board equivalent or other agency worried about aquifer "degradation".

In summary, I find this a pretty poor application to use as a model, especially for hydrocarbon bearing aquifers. But hey, what do I know. On the other hand, it opens up a whole new opportunity to perhaps permit injection wells and exempt aquifers on a well by well basis and in a single step, thus killing two birds with one stone, but multiplying the stones manyfold.